DOCUMENT RESUME

ED 094 352 CS 001 253

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TITLE Differential Response to Inserted Questions When Learning from Written Materials Containing Two Modes of Instructional Content.
PUB DATE Apr 74
NOTE 44p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, April 15-19, 1974)

EDRS PRICE MF-$0.75 HC-$1.85 PLUS POSTAGE
DESCRIPTORS Cognitive Processes; *Educational Research; High School Students; *Learning; *Learning Processes; *Questioning Techniques; Reading

ABSTRACT

This study examined the effects of verbal and perceptual aspects of learner aptitudes in relation to inspection behavior performed while learning from written materials containing two modes of instructional content. Specific predictions were based on the theoretical consideration that requirements of different modes of instructional content were sufficiently different to produce different ability-performance relationships. Seven passages of about 225 words each were selected from science instructional materials containing both test and diagrams. Four questions were written for each passage, two asking for information from the text and two asking for information from the diagrams. One hundred eighty-five high school students were randomly assigned to one of six treatment groups in a three (text, diagram, or no inserted questions) by two (highlighting or no highlighting) factorial design. Subjects who highlighted were instructed to mark important information with felt-tip marker. The results indicated that answering inserted questions facilitated acquisition of information from diagrams while answering diagram questions had a lesser effect on acquisition of information from the text and that highlighting seems to inhibit performance on relevant posttest questions. (WR)

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DIFFERENTIAL RESPONSE TO INSERTED QUESTIONS WHEN LEARNING FROM WRITTEN MATERIALS CONTAINING TWO MODES OF INSTRUCTIONAL CONTENT

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A Paper Presented at the Annual Meeting of
American Educational Research Association

Chicago, 1974

CS 001 253

DIFFERENTIAL RESPONSE TO INSERTED QUESTIONS WHEN LEARNING FROM WRITTEN MATERIALS CONTAINING TWO MODES OF INSTRUCTIONAL CONTENT

Learning activity can be directed by placing cues and prompts, such as questions, directions, diagrams, examples, within written material. These direct the learner into the vicinity of the instructional objective (Hall, Lund, and Jackson, 1968), guide the selecting and processing of appropriate instructional objectives (Walter and Buckley, 1968), and shape the selection and processing of appropriate stimulus components (Bruning, 1968; Rothkopf, 1966; Frase, 1969). All these activities are classified as mathemagenic activities. While some are considered to be gross motor in nature, such as manipulating objects, and therefore are observable and easy to measure, others include such covert inspection and processing activities as scanning, translating, formulating mental associations, discriminating, focusing, elaborating, and categorizing. The potential for instructional flexibility derived from the manipulation of mathemagenic activity underscores the need for their careful study.

It was the intent of this study to examine the effects of verbal and perceptual aspects of learner aptitude, in relation to inspection behaviors performed while learning from written materials containing two modes of instructional content.

Theory and Research

Mathemagenic Activity

The mathemagenic hypothesis recognizes a difference between the physical stimulus of instructional material and the effective stimuli learners construct

for themselves using various covert and overt behaviors. Observable activities may include orienting activities which direct learners to the vicinity of instructional objects and keep them there for suitable time periods; other activities serve to select and procure appropriate instructional objects once in the vicinity (Rothkopf, 1970). Hypothetical activities may also be performed and are, in general, of greater interest to research in view of their potential to facilitate learning. One function of mathemagenic activities is to describe processes learners may utilize in order to incorporate prior learnings into otherwise unfamiliar written stimuli. Which processes are evoked and utilized may potentially account for some of the vast variance between individual performances resulting from exposure to identical instructional stimuli. Instructional variables, such as questions and feedback, are responsible at least in part for the shaping and practice of internal processing activities.

In studies concerned with the influence of hypothetical methemagenic activity such as inspection behavior, it is important to demonstrate that instructional events do exert an influence upon the activity and no just a direct instructional effect upon acquisition. Direct instructional effects, as reported by many studies (Hershberger, 1964; Keislar, 1960; Rothkopf, 1963, 1965, 1966; Rothkopf and Coke, 1966), generally contribute the post-test performance to the repetition and practice learners have when responding to content loaded questions within the written material. However, a performance on a post-test can be contributed to modified inspection behavior and not practice and repetition when the information retained was incidental to the inserted content loaded questions.

Ample evidence is available describing various characteristics of questions and their potential to influence hypothetical activity related to learning. Findings indicate that a simple change in question location within the written material can radically transform consequent behaviors associated with reading (Bruning, 1968; Frase, 1967; 1968a; Rothkopf, 1966; Rothkopf and Bisbicos, 1967). The general implication of these studies is that placing relevant questions after paragraphs may positively influence both a review and a general facilitative effect upon acquisition of information. Other findings indicate that the nature of the response significantly influences retention of incidental information (Watts and Anderson, 1971; Frase, 1970) in that questions requiring application of concepts exhibit a greater influence than questions requiring the recall of specific facts.

Theory of ATI Research

Developing an effective means to influence the internal processing activities of learners must be linked with learner characteristics recognizing the variety of ability patterns that occur among individual learners. Cronbach (1965) and Cronbach and Snow, (1969) have proposed a framework, commonly called Aptitude x Treatment Interaction (ATI) which provides a means for relating instructional variables to learner characteristics. According to this framework, an interaction between learner aptitude and treatment condition is present when one instructional treatment is significantly better for one type of learner while an alternative treatment is significantly better for a different type learner.

Identification of Relevant Aptitudes

Melton's (1967) multiprocess model of learning is considered to be a suitable framework for investigating instructional differences and mediational requirements between specific instructional variables.

Differences and similarities in task and aptitude variables involved in learning from different modes of information within instructional material may be presented in terms of this paradigm, as presented in Table 1. It should be emphasized that this model has been used as a heuristic device in attempting to select and organize task and ability variables. Further research will be required to clarify the use of this model.

Insert Table I about here

Subjects reading textual information must first differentiate relevant specifics and their associations and then code these in memory, all steps requiring abilities in comprehension of verbal information and short term memory. Subjects learning from diagrams with many parts and various modes of information would depend upon abilities in perception in order to differentiate stimulus components. While the textual information may require subjects to generate associative structures for processing the various stimulus specifics and their associations, diagrammatic information presents specifics within a visual organization of proximity and sequence.

Only a small number of research studies have attempted to associate instructional treatment variables with learner characteristics. Koran, M. L. and Koran, J. J. (1972) predicted that the pacing of questions would

exhibit varying facilitative effects, depending upon specific learner differences in learning ability. Their findings indicated that measures of learner associative memory were positively related to performance when subjects received inserted questions, but unrelated when they received no inserted questions.

Based upon this theoretical framework and previous research, it was expected in this study that variations in treatment conditions would influence the acquisition of both relevant and incidental information from both modes of instructional content (diagrams and text). Furthermore, it was anticipated that learner performance would exhibit differential response to the treatment conditions.

Methods and Materials

Seven brief passages of about 225 words each were selected from science instructional materials containing both text and diagrams. Four questions were written for each passage; two of these asked for information from the text and two for information from the diagrams. These questions were then tested in order to determine their relative independence and then assigned to either a set of relevant text questions, incidental text questions, relevant diagram questions, or incidental diagram questions. The science materials were then modified by inserting either the relevant text questions for all the relevant diagram questions after each appropriate reading passage. All four sets of questions comprised the posttest.

185 high school students were randomly assigned to one of six treatment groups in a 3 (text, diagram, or no inserted questions) by 2 (highlighting or no highlighting) factorial design, as reported in Table 2.

Insert Table 2 about here

Subjects who highlighted were instructed to mark "important information" with a yellow felt-tip marker. Following the completion of the treatment materials, each subject completed a posttest. Subjects were also given a set of aptitude measures selected from the Kit of Reference Tests for Cognitive Factors (French et al, 1963) representing perceptual, verbal and memory abilities.

Reliabilities using the Cronbach alpha (1970) were calculated for the posttest measures, ability measures, and part scores as well. These reliabilities are reported in Table 3. Generally, the reliabilities were considered to be acceptable.

Insert Table 3 about here

Results

Data Sources

Inspection behavior is an intervening variable credited with influencing the acquisition of information from instructional materials, such as prose. However, the study of inspection behavior is limited to the analysis of indirect evidence, identified here as either an independent or dependent measure. Independent measures include those which potentially may predict a learner's performance relative to a specified instructional treatment, generally described as aptitudes, time, and inserted question scores. Dependent measures included evidence describing performance variables which were influenced in some way by experimental manipulation, generally described

as posttest measures of the acquisition of relevant and incidental information from textual and diagrammatic portions of instructional materials.

Data Analysis

A 3 x 2 analysis of variance test was used to determine if there were significant treatment effects. A scheffe test procedure (Winer, 1971) was used to determine the location of significant differences. Relationships between aptitude and criterion scores were interpreted following significant F tests for heterogeneity of regression, indicating significant intersections of regression lines for alternative treatments.

Instructional Treatment Main Effects

Information in this study was defined to be relevant when it was the intended answer to the inserted question. All other information was identified as incidental. Hence, questions on the posttest that are the same as those inserted into the written passage become the measures for the acquisition of relevant information. These questions are identified as relevant diagram questions and relevant text questions. The other questions therefore ask for incidental information and are identified as incidental text questions. These four subsets of posttest questions were analyzed to determine the instructional main effect relative to the acquisition of incidental and relevant information.

An inspection of the means for all treatment conditions, as reported in Table 4, identified potential between group differences relative to

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Insert Tables 4 and 5 about here

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performance on subsets of posttest questions. An analysis of variance on each set of scores from these subsets of questions, as reported in Table 5, revealed significant between-group differences for the inserted question treatment condition for both relevant diagram questions ($F=6.32$, $p < .05$) and relevant text questions ($F=8.94$, $p < .01$). A pair-wise comparison revealed that subjects who received inserted text questions performed significantly better on the posttest relevant text questions than other subjects; also, subjects who received inserted diagram questions performed significantly better on posttest relevant diagram questions. (See Tables 6 and 7). A significant difference also occurred between highlighting treatment conditions relative to performance on posttest intended diagram

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Insert Tables 6 and 7 about here

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questions ($F=6.45$, $p < .05$). Generally, Ss who did not highlight written passages performed significantly better on posttest relevant diagram questions than those who performed highlighting activity.

Evaluation for Aptitude x Treatment Interactions (ATI)

Aptitude x treatment interactions were evaluated by comparing regression slopes for different treatments, using F tests for heterogenicty of regression. Analysis which disclosed significant interactions were then presented in graphic form. Subsequent discussion and interpretation of these interactions were based upon the illustrations. Although many F tests were calculated and few were significant, generally those F tests that were significant followed closely to the theoretically expected relationships.

Results of regression analysis for ATI using the scores on relevant and incidental diagram questions as the performance measure are summarized in Table 8. These results disclosed significant interactions between

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Insert Table 8 about here

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treatment time and relevant diagram questions ($F=2.30$, $p < .01$) and between inserted questions and relevant diagram questions ($F=5.41$, $p < .01$). These interactions are illustrated in Figure 1 and 2. Of particular interest is

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Insert Figures 1 and 2 about here

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the disordinal interaction in Figure 1 between treatments without inserted questions (NQ/H; NQ/NH). Here, treatment time was positively related to performance on diagrams when Ss performed highlighting activity, while without it, treatment time was negatively related to performance. This finding seems to suggest that under certain conditions, highlighting may serve to maintain inspection behavior. This is also supported by the generally positive relationships in Figure 2 between treatment conditions with highlighting and performance on relevant diagram questions. The observation that inserted diagram questions exhibited a stronger positive relationship to performance on relevant diagram questions is evidence of retention of information since the inserted diagram questions and the relevant posttest diagram questions were identical.

Regression analysis using scores on relevant and incidental text questions as performance measures are summarized in Table 9. These analysis

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Insert Table 9 about here

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show significant interactions for the object-number aptitude measures ($F=2.52$, $p < .05$), treatment time ($F=4.06$, $p < .01$), and inserted questions ($F=3.04$, $p < .05$). Treatment time also produced significant interactions with incidental text questions ($F=2.65$, $p < .05$).

The effects of object-number measures upon posttest performance is illustrated in Figure 3. Object-number aptitude is a measure of associative measure. Here, inserted questions may identify discrete sets of information, allowing Ss high in associative memory to capitalize upon their ability.

Insert Figures 3 and 4 about here

The number of inserted questions answered correctly was positively related, as illustrated in Figure 4, to all treatments, but strongly related to treatments with inserted text questions. Answering inserted diagram questions when accompanied with highlighting also seemed to facilitate a higher posttest performance on relevant text questions.

The significant interactions between posttest performance on relevant text questions and treatment time and posttest performance on incidental text questions and treatment time are illustrated in Figure 5 and 6.

Insert Figures 5 and 6 about here

In both cases, treatment conditions with either text questions and no highlighting (TQ/NH) or no questions and highlighting (NQ/H), treatment time was positively related to posttest performance on either relevant or incidental text questions. The condition text questions and highlighting displayed a strong negative relationship between treatment time and post test performance on relevant text questions and a less negative relationship to incidental posttest text questions. Here a disordinal interaction suggests that this treatment condition facilitates learning when treatment time is limited (less than about 20 minutes). A similiar relationship between conditions with diagram questions and no highlighting (DQ/NH) suggests that when time is limited (about 16 minutes) inserted diagram questions facilitates acquisition of incidental text information (Figure 6), and to a lesser extent, relevant text information (Figure 5).

Discussion and Interpretation

This study sought to examine the effects of verbal and perceptual aspects of learner aptitudes, in relation to inspection behavior performed while learning from written materials containing two modes of instructional content. Specific predictions were based on theoretical considerations which suggest that requirements of different modes of instructional content were sufficiently different to produce different ability-performance relationships.

Effects of Inserted Questions

The effects of inserted questions in written passages provides a means to contrast the acquisition of relevant and incidental learning. While the analysis of variance and subsequent comparisons to determine the effect that inserted questions may have had upon incidental learning

proved to be insignificant, significant results were obtained between inserted questions and relevant learning. Regression analysis between the number of inserted questions answered correctly and the performance on any set of posttest questions was generally positive. Answering inserted text questions facilitated acquisition of information from diagrams while answering diagram questions had a lesser effect on acquisition of information from the text. It is possible that processing activities in each case are performed differentially in that learners utilize a different type of processing with diagrams than with texts.

The observations must recognize the existance of an additional multiplier which is involved when considering the relative facilitative effects of inserted questions upon relevant versus incidental learning.* This multiplier refers to the fact that the relevant information, as measured by the relevant posttest questions, represents fairly limited sized population of content while the incidental information represents a much larger sized universe of content. Subjects in the treatment groups with the relevant inserted questions are cued to the information necessary for acquisition in order to produce better posttest performances. Therefore, they can attend to less information than subjects in other treatments would have to consider in order to achieve the same posttest performance. It is therefore hard to tell how powerful the influence of inserted questions really is on these two performances, even when the posttest questions are the same.

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*Personal communication from E. Z. Rothkopf.

Effects of Highlighting

Highlighting activity seems to inhibit performance on relevant posttest questions, as reflected by the differences between group means. Regression analysis revealed that when highlighting occurred without any inserted questions, a positive relationship occurred between treatment time and relevant posttest performance, indicating that highlighting potentially may exert an influence upon inspection behavior. While the beneficial effects of highlighting, when they occur, can be interpreted as a means to focus and maintain attention to important specifics, this type of treatment was found to interfere with the attainment of high performances. This finding is consistent with studies where a high amount of repetition or attention to detail fails to produce the higher performance (Rothkopf and Coke, 1966; Rothkopf, 1968).

Aptitude x Treatment Interactions

In order to search out relationships between learner aptitudes and instructional treatments, treatments must be designed that capitalize upon the individual learner's habits and learning set. Treatments that strongly influence these habits and learning set usually fail to expose learner characteristics and performance relationships. Therefore, the fact that the treatments in this study displayed no major significant advantage for one over another indicates that they may be suited for the investigation of aptitude x treatment interaction.

Interactions occurred between treatment time and posttest performance and one aptitude factor test with posttest performance. While treatment time may seem to be an unlikely aptitude, aptitude here has been defined as any characteristic of the learner which facilitates or interfers with his learning from some designated instructional method (Cronbach and Snow, 1969).

Treatment Time. Taken as a whole, the patterns of treatment time and performance relationships suggest that the effects of highlighting or questions inserted into the written passages can facilitate acquisition. However, when both are present, a heavy burden is placed upon the "physical doing" within the treatment materials producing in some cases a lower performance. This suggesting that the treatment has interfered with effective processing of the material causing an attenuation of performance through boredom or fatigue. A similiar effect was observed for treatments with only inserted diagram questions and no inserted questions. Evidentally these conditions provide little influence and, as a result, the learner adopts less productive behaviors, at least in terms of time.

How a learner spends his time acquiring information from instructional material is of basic importance. It can be shown that the time expended and the resulting performances are concomitant variables within instructional conditions. However, the relationship may be inverse, rather than direct.

Aptitude factors. Of the five aptitude factors studied, only the object-number factor test was found to significantly interact with treatment conditions, relative to performance on the relevant text questions. Subjects who scored high on the object-number test also benefited most from treatments with text questions with or without highlighting activity and least from diagram questions without highlighting. It follows that the insertion of questions serve to-clarify the nature of the associations to be formed and thus allow associative memory to be more effectively utilized. This finding is consistent with other research (Koran, M. L. and Koran, J. J. 1972) where treatment conditions with high frequency of inserted questions benefited subjects high in measures of associative memory.

An interaction of borderline significance was reported in Table 8 between number comparison factor test and treatment conditions, in relation to performances on relative diagram questions. An analysis of this interaction indicates that performances in treatment conditions with diagram questions with highlighting were generally better but without a strong relationship to perceptual speed and accuracy. The same was found for all other treatments with highlighting. Evidentally, highlighting activity as well as diagram questions may minimize the demands upon perceptual speed and accuracy and permit subjects to capitalize on other aptitudes in the processing of diagrammatic information. Without these prompts, subjects must find and accurately identify important information within the diagram.

Conclusion

The relationship between external factors and their influence upon inspection behavior has persisted without general support (Watts and Anderson, 1971; McGaw and Groteleuschen, 1972). Considering the seemingly conflicting roles inserted questions and highlighting seem to exhibit, inspection behavior may or may not be influenced in some of the treatment conditions presented, and therefore may be also dependent upon the mode of information, the difficulty of the material and questions, and relevant learner characteristics. Therefore, the actual effects of the external instructional variables must be examined relative to the individual differences of the learners. Varying the modes of instructional content seems to increase these differential effects.

This research has attempted to further examine the relationships between individual differences and inspection behavior relative to learning from different modes of instructional content. The materials utilized approximated classroom written materials for science instruction. The subjects

were younger high school age rather than the typical college aged subjects utilized in most other studies concerned with inspection behavior. While immediate and practical application may not be possible, further research will eventually provide some decision rules for modifying instruction and for assigning learners to alternative instructional treatments to teach the same terminal objectives (Koran, M. L., 1973).

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TABLE 1

ORGANIZATION OF TASK AND APTITUDE VARIABLES
IN A MULTIPROCESS MODEL OF LEARNING

	$s_1 \rightarrow r_1(s_1)$ Stimulus Differentiation	$r_m(s_M)$ Association, Mediation	$R_a R_b R_c$ Response Integration
Textual Information Mode	Read passages at own pace. Select solely verbal specifics for coding. Code in verbal representation.	Review specifics in memory. Generate associative context.	Retain written verbal associations. Generate verbal recall responses to test-like events.
Diagrammatic Information Mode	Inspect and read diagrams. Select verbal and figural specifics for coding.	Review specifics in memory. Review associative context of diagram and specifics. Generate verbal linkage for figural specifics.	Retain verbal and figural specifics. Generate verbal recall responses to test-like events.
Aptitude Variables	Flexibility of Closure. Perceptual Speed. Verbal Comprehension.	Verbal Association. Verbal Comprehension.	Associative Memory. Verbal Association. Short Term Memory.

TABLE 2

EXPERIMENTAL DESIGN

Treatment		
Highlighting	Inserted Questions	Post-Test
X	Diagram questions	O_1
X	Text questions	O_2
	Diagram questions	O_3
	Text questions	O_4
X	No questions	O_5
	No questions	O_6

TABLE 3

RELIABILITY OF MEASURES

Measure	Number of Items	Reliability
Criterion Measures		
Post-test	28	.78
Relevant Text Questions	7	.48
Incidental Text Questions	7	.51
Relevant Diagram Questions	7	.47
Incidental Diagram Questions	7	.46
Ability Measures		
Hidden Patterns (Cf-2)	200	.91
Vocabulary (V-2)	36	.71
Object-Number (Ma-2)	15	.73
Auditory Letter Span (Ms-3)	15	.56
Number Comparison (P-2)	48	.85

TABLE 4

MEANS FOR SUBSETS OF POST-TEST QUESTIONS

Treatment Condition	Diagram Questions		Text Questions	
	Relevant	Incidental	Relevant	Incidental
Diagram questions with highlighting	2.58	2.93	1.59	2.21
Text questions with highlighting	1.47	2.90	2.17	2.00
No questions with highlighting	1.50	2.90	1.81	2.68
Diagram questions without highlighting	2.75	3.40	1.18	2.31
Text questions without highlighting	2.[illegible]0	3.48	2.55	2.45
No questions without highlighting	2.24	3.06	1.18	2.21

TABLE 5

ANALYSIS OF VARIANCE FOR SUBSETS OF POST-TEST QUESTIONS

Source of Variation	df	Diagram Questions				Text Questions			
		Relevant		Incidental		Relevant		Incidental	
		MS	F	MS	F	MS	F	MS	F
Inserted Questions	2	13.61	6.32*	0.80	0.29	17.43	8.94**	0.91	0.35
Highlighting	1	13.89	6.45*	7.54	2.76	2.13	1.09	0.03	0.01
Questions x Highlighting	2	1.71	0.79	0.76	0.28	4.36	2.23	3.35	1.28
Within	179	2.15		2.73		1.95		2.61	

*p<.05
**p<.01

TABLE 6

SCHEFFE TEST FOR DIFFERENCES BETWEEN MEANS OF INSERTED QUESTION TREATMENT CONDITION ON RELEVANT DIAGRAM QUESTIONS

Procedural Step

Treatment Groups		1 Diagram Questions	2 Text Questions	3 No Questions
	Means	2.67	1.83	1.88
	Number of Subjects	61	59	65
Scheffe S's	Contrasted Pairs	1-2	1-3	2-3
	Difference Between Means	.84	.79	-.05
	Scheffe S	.66	.64	.65

Probability Statements

$P_{12}(.18 \leq \mu_1 - \mu_2 \leq 1.50) = .95$*

$P_{13}(.15 \leq \mu_1 - \mu_3 \leq 1.39) = .95$*

$P_{23}(-.70 \leq \mu_2 - \mu_3 \leq .60) = .95$**

*significant difference between contrasted pair
**no significant difference between contrasted pair

TABLE 7

SCHEFFE TEST FOR DIFFERENCES BETWEEN MEANS OF INSERTED QUESTION TREATMENT CONDITION ON RELEVANT TEXT QUESTIONS

Procedural Step		Results of Computations		
Treatment Groups		1 Diagram Questions	2 Text Questions	3 No Questions
	Means	1.38	2.36	1.50
	Number of Subjects	61	59	65
Scheffe S's	Contrasted Pairs	1-2	1-3	2-3
	Difference Between Means	-.98	-.12	.86
	Scheffe S	.63	.61	.62
Probability Statements		$P_{12}(-1.61 \leq \mu_1 - \mu_2 \leq -.35) = .95$*		
		$P_{13}(-.73 \leq \mu_1 - \mu_3 \leq .49) = .95$**		
		$P_{23}(.24 \leq \mu_2 - \mu_3 \leq 1.48) = .95$*		

*Significant difference between contrasted pair
**No significant difference between contrasted pair

TABLE 8

SLOPES AND INTERCEPTS FOR LINEAR REGRESSION OF DIAGRAM QUESTIONS

Predictor	Highlighting Treatments						No Highlighting Treatments						F
	Diagram Questions		Text Questions		No Questions		Diagram Questions		Text Questions		No Questions		
	a	b	a	b	a	b	a	b	a	b	a	b	
Relevant Diagram Questions													
Vocabulary, Total	.44	.12	.27	.07	.25	.07	1.53	.07	1.65	.03	-.52	.15	1.50
Number Comparison, Part 1	2.86	-.02	1.37	.01	1.65	-.01	1.95	.08	-.26	.26	.23	.16	2.12
Hidden Patterns, Part 1	1.88	.03	.27	.04	1.16	.01	2.71	.00	.63	.06	-.31	.09	1.63
Treatment Time	1.16	.05	1.89	-.02	-.41	.10	3.34	-.03	1.51	.03	3.64	-.09	2.30*
Inserted Questions	-.16	.91	.87	.23	--	--	.73	.67	1.05	.37	--	--	5.41**
Incidental Diagram Questions													
Vocabulary, Part 2	.40	.29	.65	.24	1.96	.11	1.27	.26	1.75	.19	.96	.23	.64
Auditory Letter Span	2.32	.11	1.14	.32	2.87	.01	2.45	.17	1.59	.35	3.37	-.05	1.19
Treatment Time	2.58	.01	4.11	-.05	1.83	.05	5.08	-.08	2.56	.05	3.76	-.04	1.25
Test Time	2.99	-.01	2.88	.00	2.75	.02	4.96	-.15	3.74	-.02	5.14	-.17	1.52

*p<.05
**p<.01

Note: a and b are of the form: $\bar{y} = a + bx$

TABLE 9

SLOPES AND INTERCEPTS FOR LINEAR REGRESSION OF TEXT QUESTIONS

Predictor	Highlighting Treatments						No Highlighting Treatments						F
	Diagram Questions		Text Questions		No Questions		Diagram Questions		Text Questions		No Questions		
	a	b	a	b	a	b	a	b	a	b	a	b	
Relevant Text Questions													
Vocabulary, Part 1	-.35	.23	-.46	.28	.69	.14	-.59	.21	1.95	.07	.09	.13	1.17
Number Comparison, Part 1	1.55	.00	.17	.18	1.64	.02	1.04	.01	2.98	-.04	.67	.05	1.26
Auditory Letter Span	.77	.14	-.68	.51	1.89	-.01	.65	.10	1.14	.25	.34	.14	2.01
Object-Number	1.58	.00	.99	.23	1.64	.03	1.76	-.11	2.01	.09	.95	.04	2.52*
Treatment Time	1.59	.00	4.78	-.10	-.16	.10	2.73	-.07	.89	.08	1.80	-.04	4.06**
Inserted Questions	.17	.47	.36	.69	--	--	.94	.08	.64	.60	--	--	3.04*
Incidental Text Questions													
Vocabulary, Part 2	.89	.15	.33	.18	1.83	.10	.09	.26	.26	.24	-.43	.28	.92
Treatment Time	2.87	-.03	2.61	-.02	.29	.12	4.34	-.10	.81	.08	2.71	-.03	2.65*
Inserted Questions	1.56	.21	1.21	.30	--	--	1.04	.41	1.04	.45	--	--	.34

*p<.05
**p<.01

Note: a and b are of the form: $\tilde{y} = a + bx$

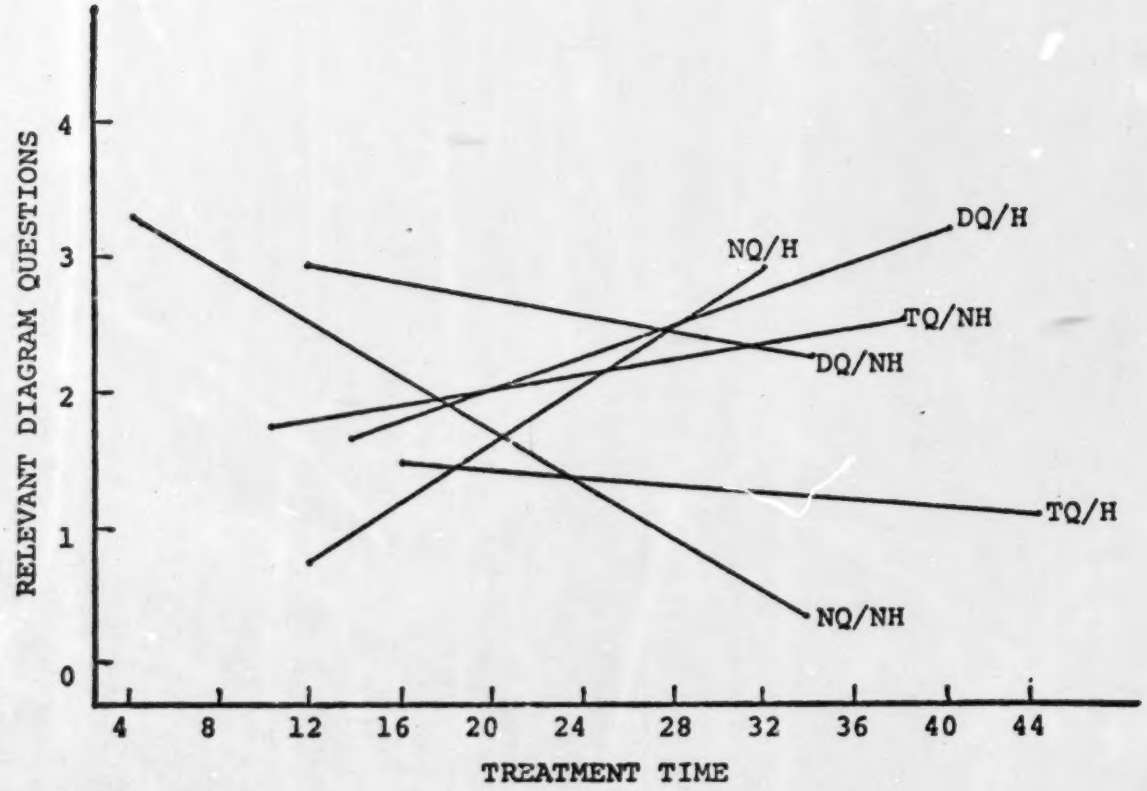

Figure 1 : Interaction of Treatment Time With Relevant Diagram Questions

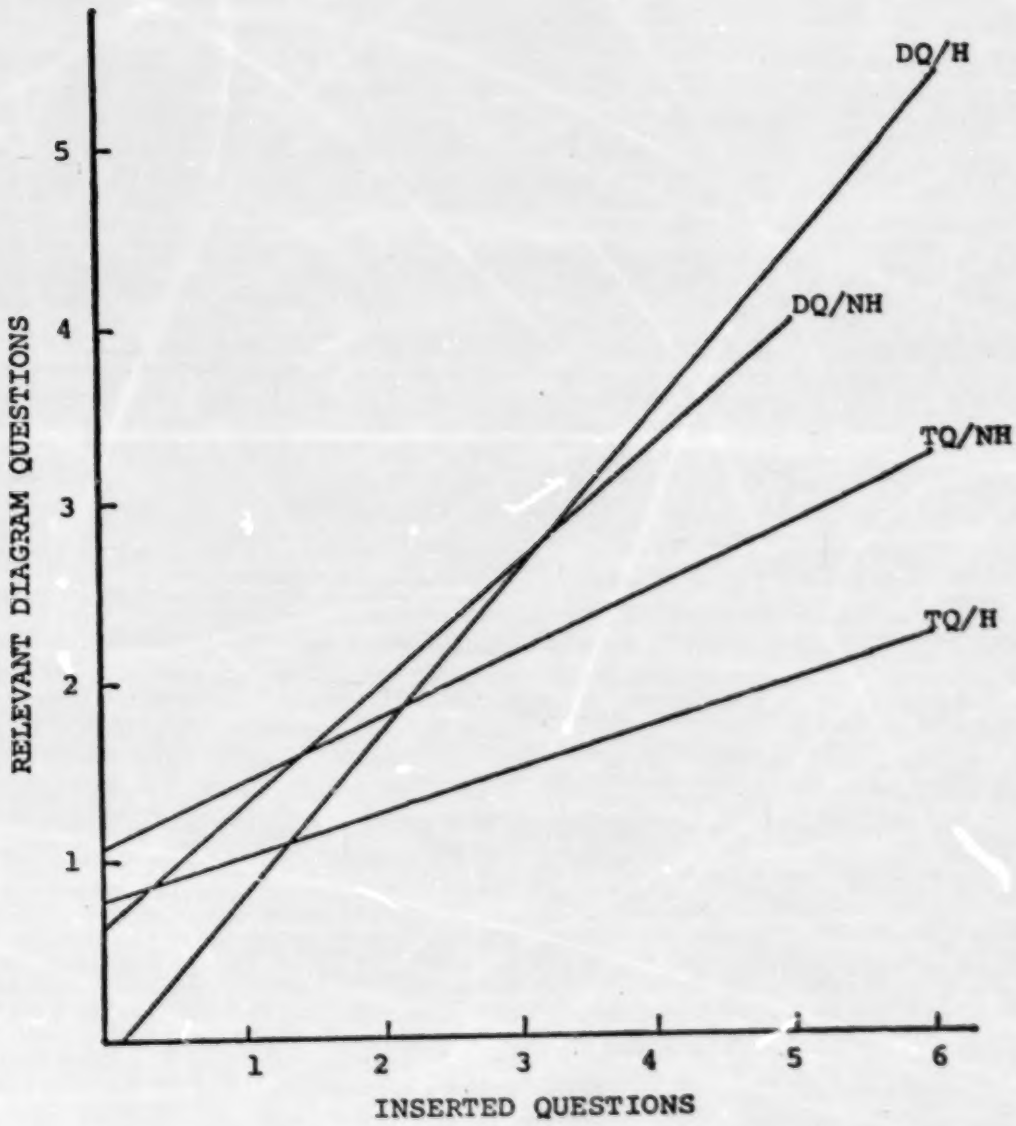

Figure 2: Interaction of Inserted Questions With Relevant Diagram Questions

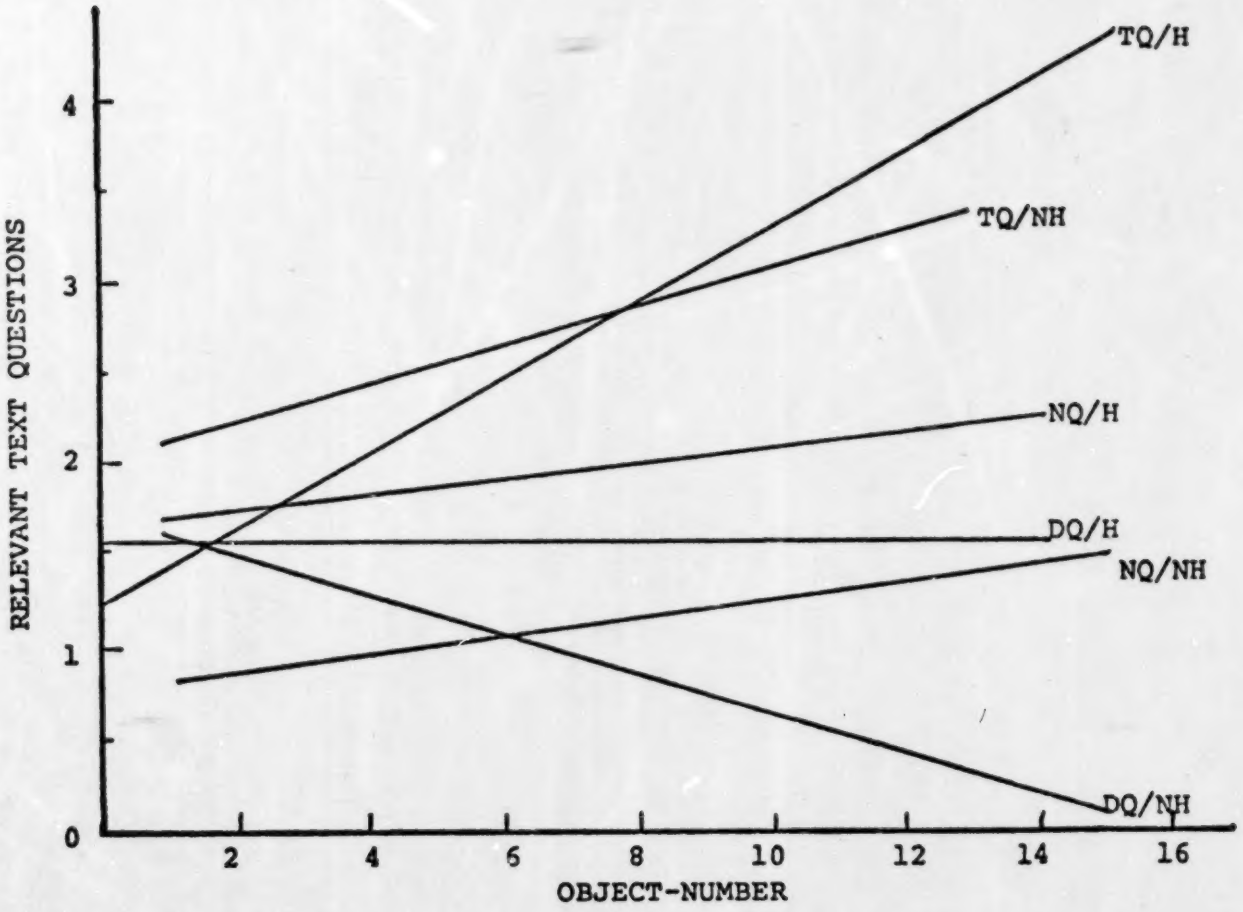

Figure 3: Interaction of Object-Number With Relevant Text Questions

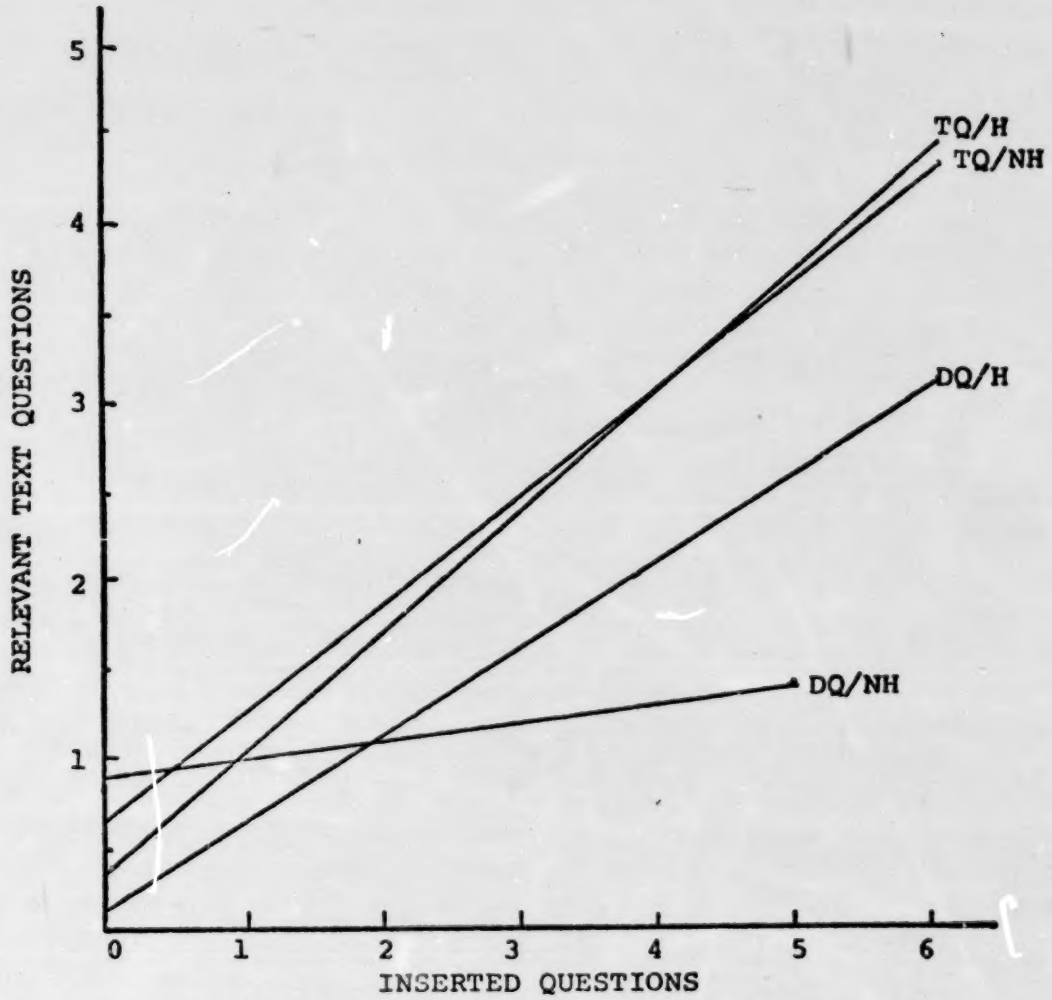

Figure 4: Interaction of Inserted Questions With Relevant Text Questions

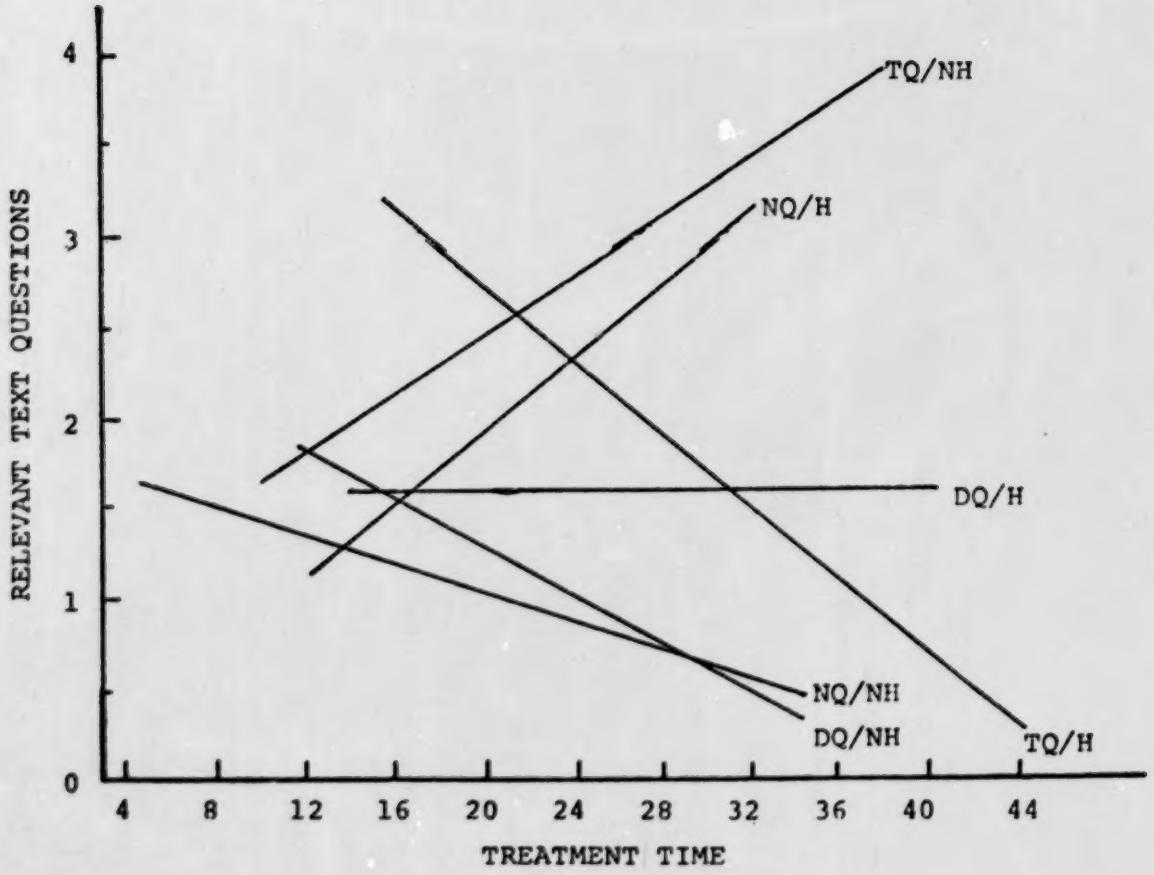

Figure 5: Interaction of Treatment Time With Relevant Questions

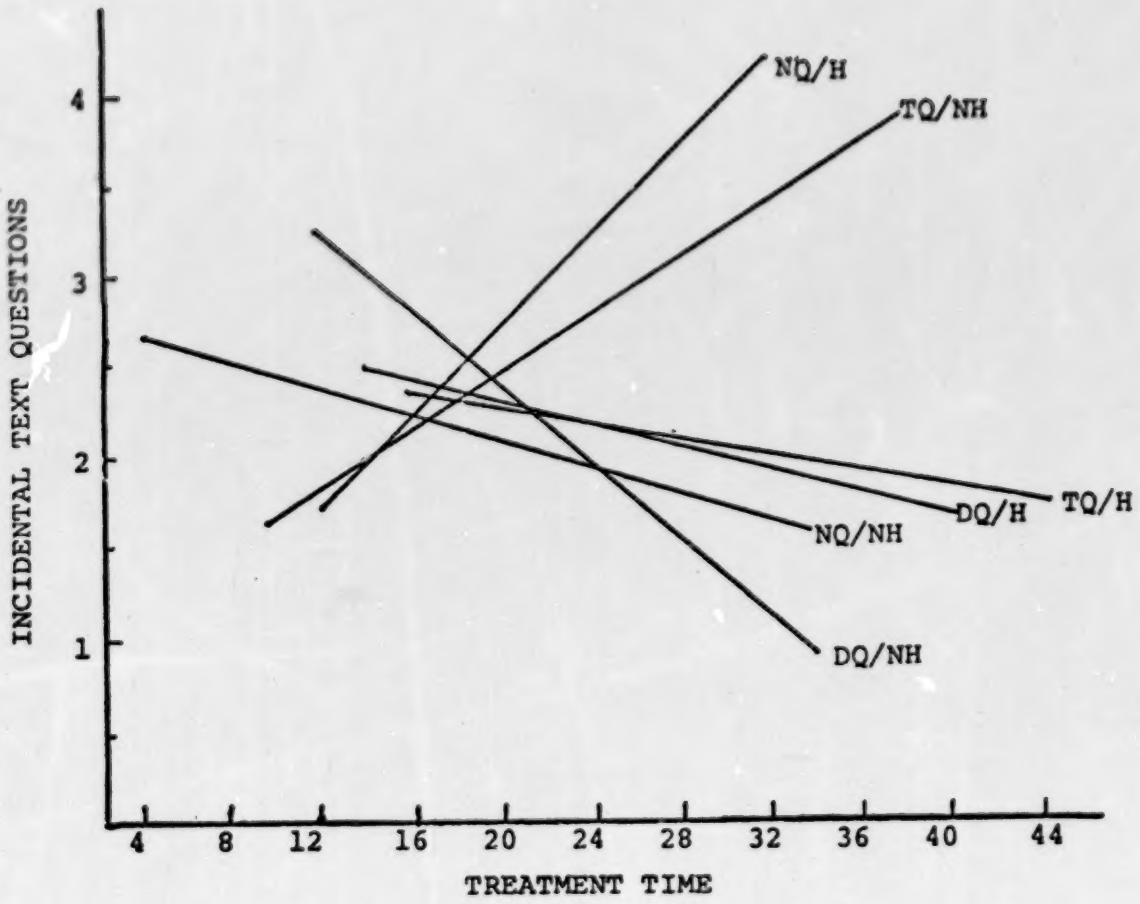

Figure 6: Interaction of Treatment Time With Incidental Text Questions